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The effect of soil penetration rate and domestic wastewater irrigation on different plants and soil systems

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Key words: Irrigation, domestic wastewater, final penetration rate.

Abstract

The main objective of this work was to study the irrigation effects by domestic wastewater on changes in final penetration rate. This experiment was carried out in a completely randomized block design in in Islamic Azad University, Shahr-e-Qods Branch, Iran by measuring essential features related to soil characteristics. After a measurement final penetration rate in irrigated soils by domestic wastewater and first and second rain, we found that average for final penetration in the irrigated Rapeseed lyesmiter soils by domestic sewage reduced to about -41%, it did reduce to -18% in the alfalfa limiter soils that were irrigating by first drainage and also it did reduce to -7% in the basil lyesmiter soils that it is irrigated second drain all of these results were as compared with control.

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Introduction

Using uncommon water sources such as wastewaters is one of the ways to conflict with shortage of water resources. So, it is necessary that we have a scientific and research perspective on the agric water soil. This matter is important when we know that after irrigating to sewage, parts of the soluble ions in these wastewaters with nutrient and useful material and even harmful elements enter to soil (Wahid *et al*., 2000; Vasudevan *et al*., 2010; Oregani *et al*., 2014). Soils are consisted of organic and mineral materials, water, air and micro-organisms and they always are exposed to physical and chemical changes, on the other part domestic sewages has not useful and heavy elements such as cadmium, zinc and merry. However, human were excreta part of proteins and vitamins and consequently after irrigated by domestic sewage supply parts of nutrient and useful materials in the soil. If he uses of domestic sewage instead pit water for irrigating agricultural crops it improves permeability and porosity. Properties for soil and soil texture become in sponge form (Bouwer and Idelovitch, 1987). Some researches were reported that irrigation of the landform by urban and domestic wastewater for long time will fall in effect on the soil hydraulic conduction but it will lead to stability for soil particles as passed water flow reduce to soil surface. It is evident that after repeated irrigation by sewage for long time, most take place keeping and with proposing these results and other results. It supposed that irrigation toy uncommon water such as domestic sewages can has useful and destructive effects on the structure and other physical and chemical soil parameters (Mancino and Pepper, 1992; Mosab, 2000; Oron *et al*., 1986; Scott *et al*., 2004). Therefore, it is important for study process related to water penetration rate in the soil. Permeability is a parameter that based on it, irrigation method (dropping, superficial, raining) will select. The main aim of this research was the study of irrigation effects by domestic wastewater on changes in final penetration rate.

Materials and methods

This study was conducted on experimental lysimeters of Islamic Azad University, Shahr-e-Qods Branch of Tehran at Iran in 2011, The volume of each lysimeter was 150 lit (Height = 100 cm and Radius = 60 cm) filled by soil and in order to prevent water influx from field to lysimeters, those placed on metal legs (height = 40 cm). After filling lysimeters by clay loam soil, plants seeds were planted and were irrigated with agronomical water rapeseed *(Brassica napus* L.), alfalfa (*Medicago sativa* L.) and basil (*Ocimum basilicum* L.) were used in this experiment. In this experiment, we had 15 lysimeters, that were planted rapeseed in 1 to 5 lysimeters and were irrigated by domestic wastewater with BOD_5 about 150 mg/lit and primary drainage water were accumulated. In the 6 to 9 lysimeters was planted alfalfa and were irrigated by primary drainage water and then, were accumulated secondary drainage water. We have irrigation 10, 11 and 12 lysimeters by secondary drainage water that was planted inside the basil. In order to compare plants characteristics, in 13, 14 and 15 lysimeters were planted rapeseed, alfalfa and basil respectively and were irrigated by agronomical water (Fig. 1).

Results and discussion

After studding and calculating various amounts of final penetration rate for domestic wastewater and it drain in the liesmiter soils containing cholze , basil and alfalfa, we achieve useful results which are shown in Tables 1,2 3, 4, 5. Agricultural stages for sowed plant take place. Based on irrigating rounds and aquatic requirements of the plants and till rapeseed, alfalfa and basil reaching to final growth seed and leaves, they has irrigated to domestic sewage and drain treatment, in that level penetration rate measured by using of the penetration rate equation in the doubled cylinders. In order to measuring final penetration rate in the soil in lysimeter applied 2 doubled cylinders to genus of white iron to 25cm in diameter and 20cm in height. In reality, cause for use of equation and doubled ring is that we work to short term efficiencies in irrigation systems, there fore this equation give us better results at short term periods. After preparing doubled rings have placed them to

height about 15cm in the lysimeter soils. Then swage water in cylinder gradually penetrate in side lysimeter soils, it is mentionable that this test take place in all the Rapeseed, alfalfa and basil and pit water lysimeter and obtained digits are moderate average of 5 lysimeters that during this study doesn't show any significant different. Of course, the reason for use of 2 doubled rings is that preventing of side penetration of the water in the soil. Along examination we effort with cordial addition of water inside rings fixed water surface in cylinders and by means of volume of additive water in cylinders and dividing it on section surface of cylinder, we able to cul-watering penetrated water height. By this meaner, test is carried out accurately. for each lysimeter need to 100 minute times for calculate permeability rate of water in the lysimeters soils, which in one a growth season are irrigated by domestic sewage, first drainage and second drain. Results are shown in Tables 6, 7, 8 and 9.

Table 1. Physical–chemical properties of the soil in lysimeter before irrigating domestic wastewater and drains.

SAR	pH	EC (ds/m)	Total Porosity (%)	Bulk Density (gr/cm3)	Soil moisture		Soil Texture (%)		
-	-	-	-	-	FC	PWP	Clay	Silt	sand
8.72	7.2	5.68	38	1.52	13.7	6.14	30	28	42

Table 2. The properties of predefined domestic wastewater for irrigated Rapeseed lysimeters.

Parameter	Na	Mg	Ca	Cl	TSS	SAR	pH	EC	COD	BOD5
	meq/lit			meq /lit		-	-	ds/m	ppm	ppm
Value	24	14.7	15.0	1.8	208.1	5.81	7.20	4.80	232	150

Table 3. Physical–chemical properties (Alfalfa lysimeter).

Parameter	Na	Mg	Ca	Cl	TSS	SAR	pH	EC	COD	BOD5
	meq /lit			meq /lit		-	-	ds/m	ppm	ppm
Value	18.10	12.17	12.20	1.60	19.17	4.82	6.98	3.81	30	15

Table 4. The properties of second drainage result from Rapeseed lysimeters.

Parameter	Na	Mg	Ca	Cl	TSS	SAR	pH	EC	COD	BOD5
	meq /lit			meq /lit		-	-	ds/m	ppm	ppm
Value	17.92	11.98	12.10	1.50	188.14	4.63	6.94	3.42	8	5

Table 5. Control water for irrigating Rapeseed, Alfalfa and Basil.

Parameter	Na	Mg	Ca	Cl	SAR	pH	EC	COD	BOD5
	meq /lit			meq/lit	-	-	ds/m	ppm	ppm
Value	9/40	2/81	5/02	7.42	5.01	7.60	1.62	18.01	2.42

Table 6. The penetration rate for water in soil in each of Rapeseed lysimeter of the 100 minutes.

Parameter	Na	Mg	Ca	Cl	SAR	pH	EC	COD	BOD5
	meq /lit			meq/lit	-	-	ds/m	ppm	ppm
Value	9.40	2.81	5.02	7.42	5.01	7.60	1.62	18.01	2.42

Table 7. Irrigated Rape Seed by predefined domestic wastewater.

Parameter	Na	Mg	Ca	Cl	TSS	SAR	pH	EC	COD	BOD5
	meq/lit			meq/lit		-	-	ds/m	ppm	ppm
Value	17.92	11.98	12.10	1.50	188.14	4.63	6.94	3.42	8	5

Table 8. First drain from Rapeseed lysimeter, perching domestic wastewater.

Lysimeter	1st lysimeter	2nd lysimeter	3rd lysimeter	4th lysimeter	5th lysimeter	Control
	mm/min	mm/min	mm/min	mm/min	mm/min	mm/min
Penetration rate	0.56	0.56	0.57	0.56	0.57	0.57

Table 9. Second drain from Alfalfa and Basil, predefined.

Lysimeter	1st lysimeter	2nd lysimeter	3rd lysimeter	4th lysimeter	5th lysimeter	Control
	mm/min	mm/min	mm/min	mm/min	mm/min	mm/min
Penetration rate	0.56	0.56	0.57	0.56	0.57	0.57

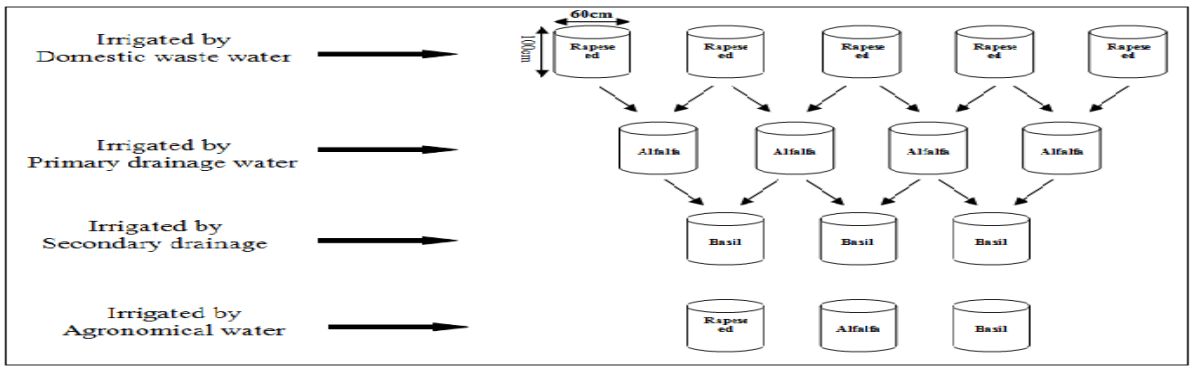

Fig. 1. Characteristics of lysimeters for irrigation of the studied plants.

After, found penetration rate in each of lysimeters contain rapeseed. Alfalfa and basil that their interior were filled by similar soil were farmland before examination, each of averages in ever row of lysimeters be compared to control sample itself and together. Results analysis and decreasing and increasing percentage for permeability in each of treatments was presented in results and discussion.

Results of radius of final penetration rate for domestic sewage and drain in the lysimeter soils containing rapeseed, basil and alfalfa were presented in table of final penetration rate of domestic swage and first drainage as compared with control. Results revealed that soil and plant has played important roles in filtration of raw sewage, because of reducing final penetration rate for sewage and it is drain that is suspended materials on the filtered domestic sewage, which were using for irrigating rapeseed, were than first and second drainages and pit water. Also, suspended and nutrients materials on the first drain was more than second drain and pit water. Thus, when we moved to front, difference between second drain and pit water with respect to their final penetration rate, was became smaller (7 percent). This show that domestic sewage after passing of soil and rapeseed filters leave parts of suspended and organic material itself in Rapeseed soil. In addition, results of first and second drains analysis also emphasize this subject.

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